1. Introduction

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A great deal of progress has been made in the last thirty years in producing numerical models for predicting ground response and soil-structure interaction subjected to strong ground motion. It is fair to say, however, that there is still much to be learned. The vital missing element is appropriate validation of these models for different soil types and boundary conditions, requiring significant numbers of strong ground motion records showing how soil response changes with depth, as well as reference motions for a range of structure types and well designed experimental strong motion arrays. Records must be obtained for different well-characterized soil profiles where the soils have been driven into the nonlinear range; it is also necessary to understand how surface waves and basin effects influence the response at a particular location. These are the data required to properly evaluate proposed numerical models.

A complete geotechnical array for natural soil deposits and for major engineering structures such as earth dams would consist of one or more instrumented boreholes, in combination with surface sensors. These dense instrument arrays would measure directly the variation of ground response in three dimensions. Where appropriate, these strong-motion instrument arrays would be complemented with piezometers to measure the development of seismically induced pore water pressures, and/or with inclinometers, displacement meters, and survey monuments to measure permanent site deformations.

Experience has shown that recordings of strong ground motion large enough to calibrate models for predicting nonlinear behavior in ground response and soil-structure interaction are difficult to obtain and require significant investment of time and capital. It is, therefore, imperative that the most promising sites be found for installation of instrumentation, that painstaking soil characterization studies be done for each site, and that installation of instrumentation be properly planned. Further, long-term maintenance and even improvements to the instrumentation must be done, over what may be a long waiting period, in anticipation of a strong-motion event. This is a critical point and, arguably, one of the most difficult obstacles faced by researchers and strong-motion network operators. When a major event occurs, it is essential that the following parameters are met: the instruments must be in proper working order; the site characteristics must be well documented; and all information subsequently collected must be readily accessible in an agreed-upon format.

Consequently, it is critically important to develop an overall strategy and a comprehensive plan of action as the guiding basis for allocating resources to geotechnical site instrumentation. Long-term funding support is required to ensure success of the monitoring effort and thereby realize the desired return on the investment.

As a first step in planning such activities, this workshop brought together an international group of informed geotechnical engineers and seismologists to examine the current state of geotechnical array monitoring and identify needs for the future. From the twenty-two papers presented and subsequent discussions, several major points emerged:

- It is imperative that international agreement be reached on consistent seismic data formats, and on the content and format of associated metadata.
- For downhole arrays, it would be desirable to reach international accord on important details of instrument installation, and develop agreed-upon general guidelines for instrument installation and their spatial distribution.
- It would be extremely useful to develop an inventory of geotechnical arrays in the United States and abroad.
- Long-term support of geotechnical arrays in the United States is more fragmented and uncertain than in Japan, Taiwan, or the European Union. This problem requires urgent attention by the research community and strong-motion monitoring organizations in the United States.

A second workshop is planned that will focus on the development of an implementation action plan for geotechnical array installation and long-term operation to address the needs and problems identified at this meeting. In the interim, the organizers would welcome comments and advice from their colleagues in this field.